Generating Autoclave-Level Mechanical Properties with Out-of-Autoclave Thermoplastic Placement of Large Composite Aerospace Structures, Phase II

Completed Technology Project (2009 - 2011)

Project Introduction

While in the 1970's and 1980's, composites were adopted for aerospace structure for increased performance and weight savings, the 1990's and 2000's witnessed the attention towards cost-effective fabrication. All thermoset processes that utilize such machines rely on autoclaves to consolidate the laminates, at significant acquisition and operational expense. Autoclaves to consolidate wings are hugely expensive. Autoclaves for fuselages are nearly cost-prohibitive (only one exists). Autoclaves for the Ares V do not exist. The marketplace would welcome a proven out-of-autoclave fabrication technology. The tasks in the ASI/UD-CCM STTR phase 1 was to assess the performance of the current TP-ATP heads, do a model based parametric study to determine possible head and process parameter changes and demonstrate an improved understanding of the head, with a goal of autoclave level properties. A set of models for the in situ Automated Tow/Tape Placement (ATP) processes that capture the important process phenomena were developed by UD-CCM. Accudyne then measured the laminate roughness, fabricated samples using a variety of conditions and tested the samples. Testing of the laminates indicate: placing with flat tape and using improved head chilling increases mechanical properties. Compacting with only a ¼ load reduces properties. Using a vacuum bag oven reconsolidation is ineffective, and even reduces mechanical properties. The phase 2 program innovation is to develop and deploy University of Delaware process models to Accudyne's thermoplastic tow and tape placement head to remedy the mechanical property shortfall between the two fabrication processes used to manufacture large composite aerospace structure important to NASA. An additional advantage that would accrue by adopting TP-ATP would be the use of novel thermoplastic materials with thermal stability and toughness far in excess of what thermosetting materials can achieve.

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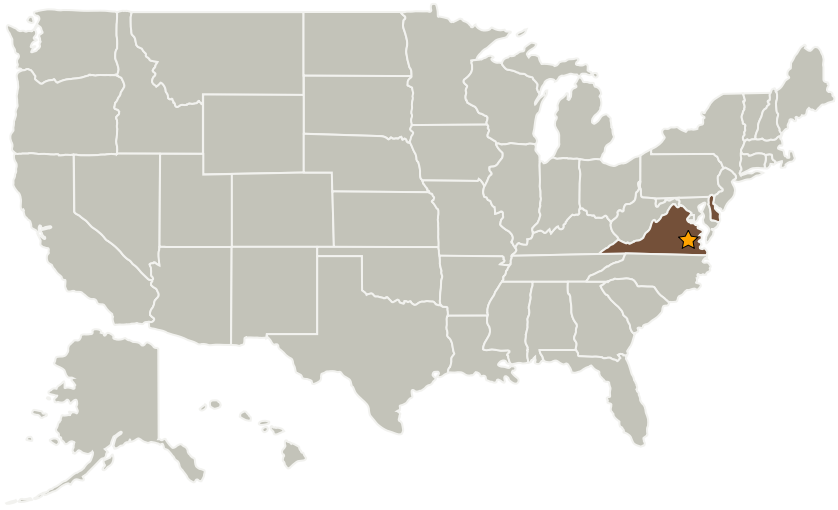
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Accudyne Systems, Inc.	Supporting Organization	Industry	Newark, Delaware

Primary U.S. Work Locations	
Delaware	Virginia

Project Transitions

June 2009: Project Start

June 2011: Closed out

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes